MACKEREL SKY AS A PROGNOSTIC OF PRECIPITATION.

By H. H. MARTIN, Observer.

[Weather Bureau, Columbus, Ohio, May 15, 1919.]

While compiling other data for investigation I have taken note of the occasional record of "mackerel sky" at the Columbus, Ohio, station. Of the 17 records made, it has been found that 10 were followed by precipitation within 12 hours, 15 within 24 hours, and 17 (all) within 48 hours. As will be agreed, the occurrence of "mackerel sky" is evidently of great prognostic value. However, the records of this formation are sparse and the value 13 does not, in my opinion, represent anything like the total number of times this cloud has been observed in the past 10 years.

I believe that this cloud formation is of sufficient importance to justify more complete records, and that it should be recorded, together with the time, direction from which moving, and where densest, whenever observed. "Mackerel sky" is usually of such short duration that an observer must be on the alert to note every occurrence. I believe that if such records were made, however, the results would be of greater value than any other cloud record in the forecast of precipitation.

ON THE USE OF CIRRUS IN THE FORECASTING OF WEATHER.

By G. REBOUL and L. DUNOYER.

[Abstracted from *Comptes Rendus*, Mar. 22, 1920, pp. 744-747.]

It is a well-known fact that the distribution of cloudiness in advance of a low pressure area can be used for local forecasting. This paper presents the deductions from observations made at Malzéville, France, regarding the use of cirrus for this purpose. The rules deduced and the factors of certainty are presented here:

1. *The appearance of cirrus in a certain direction indicates the existence of a depression in that vicinity.* Certainty: In summer, 0.92; in winter, 0.94; when cirri are from west, 0.96; from the east, 0.81.

2. *The direction of movement of cirrus indicates the direction in which the depression is to be found.* Certainty: In summer, 0.84; in winter, 0.81; when cirri are from west, 0.91; from the east, 0.57.

3. *The direction of movement of cirrus indicates the direction of motion of the center of the depression.* Certainty: In summer, 0.67; in winter, 0.60; when cirri are from west, 0.76; from the east, 0.43.

4. *Cirri of high speed foretell a rapid motion of the center.* Certainty: January to October, 1916, 0.72; July, 1918, to July, 1919, 0.68.

5. *Abundant cirrus indicates, on occasions when the depression is in the vicinity of the place of observation, where it is intense.* Certainty. 0.77.

The warning is made that too much confidence should not be placed in cirrus as precepts for forecasting, and that these rules are applicable only to LOWS in the north or east of France and in cases where the coefficient of certainty is very large.—*C. L. M.*

NOTE.—These conditions, of course, are those with which the French have to contend, but some of the above rules would not be applicable in America. The reason is that barometric depressions in America travel much more rapidly than those of Europe, and it is therefore possible that the direction of motion of cirri indicate the radial motion from the center of the storm; on the other hand, in America, the center of the cyclone moves forward much more rapidly, so that the direction of motion of cirri represent the direction of motion of the storm, but not the location of the center, as is implied in (2) above.—*C. F. B.*

THE SNOWFALL IN THE WESTERN STATES, WINTER OF 1919-20.

[Abstracted from Section Directors' Reports by A. J. Henry.]

In general the winter of 1919–20 was one of greatly reduced snowfall as compared with the normal. The distribution was abnormal in that rather heavy snow fell in the early part of the season, the greater portion of which disappeared before January 1, 1920. The fall of both January and February was much below normal and the outlook at the end of February was distinctly disappointing. The snowfall of March was fairly heavy in practically all of the Western States, but coming so late in the season it will not make up the deficiency of the midwinter months.

The most-favored districts appear to be southwestern Colorado and portions of Wyoming. Meteorologist A. H. Thiessen, in charge Climatological Service of Colorado, concludes that the flow of the Grand and Gunnison Rivers will be more than normal and that that of the Yampa, White, and San Juan Rivers will be considerably above the normal, thus giving an increased flow in the Colorado which he estimates at 30 per cent.

Snowfall in the Columbia watershed was deficient, particularly in the Coast States. Meteorologist E. L. Wells, of Portland, Oreg., concludes that with moderate, seasonable temperatures during May the run-off from the Snake River will be nearly normal and comparatively early and that nearly the usual volume of flow will come out of the Columbia.

THE DROUGHT IN CALIFORNIA.

By ANDREW H. PALMER, Meteorologist.

[Weather Bureau Office, San Francisco, Calif., April, 1920.]

In California the year is divided into well-defined wet and dry seasons. Nearly all of the precipitation occurs during the winter half-year. The character of the rainy season, therefore, determines the prosperity of agriculture, which is largely dependent upon artificial irrigation. Hydroelectricity is largely used for pumping the irrigation water.

Because of abnormally deficient precipitation during the rainy season 1919–20, the central and northern portions of California face a serious problem during the summer of 1920. As the three preceding rainy seasons have also brought deficient precipitation, and the season just ended the least in many years, the natural reservoirs are largely depleted. An inevitable shortage of water will occur during 1920 in central and northern California. Generous rains in March assured the maturing of winter growing grains and grasses, and revived fruit trees. But summer growing crops, particularly rice, and general field crops, as well as deciduous fruit, will require much more water than now appears to be available in the partially filled reservoirs. Mr. H. D. Butler, State power Administrator, estimates that the deficient rainfall of the past season will cause a loss of $22,000,000 in the Sacramento Valley alone during the summer of 1920.

The public utility commission in California is known as the Railroad Commission of the State of California. It has authority over hydroelectric power companies, and also over those water distributing companies which are classed as public utilities. Recognizing the gravity of the situation, and in the hope of preventing costly litigation, the railroad commission has organized a body called the Emergency Water Conservation Conference, which includes in its membership representatives of all the State and Federal agencies concerned with the water problem. It includes representatives of the State railroad commission, State water commission, State department of agriculture, State university, State department of engineering, United States Geological Survey, United States Weather Bureau, United States Bureau of Irrigation Investigations, and the United States Army. This conference held many meetings during March and April. Through an educational campaign the public was informed of the pending water shortage, and urgent recommendations were made for the conservation of water.

The larger water users of the Sacramento Valley voluntarily signed an agreement turning over to the conference authority to control and to apportion the available water of that valley during the summer of 1920. These water users voluntarily assessed themselves on an acreage basis an amount which will give the conference about $30,000 for administrative purposes in dealing with the water problem. As the hydroelectric power will be insufficient for pumping irrigation water, steam pumping plants are at present being installed in many places in the valley. Mr. Paul Bailey, chief engineer, has been engaged by the conference to act as water administrator, and he will spend a large portion of the summer in the field in connection with his duties.

During the summer of 1919 the Sacramento River reached unprecedented low stages. Navigation, which under normal conditions is possible to Red Bluff, was possible only as far as the city of Sacramento. While the Sacramento River is usually at a high stage during the spring months, at this writing (Apr. 13.) it is so low that it appears that the river will establish a new low record stage before the close of the summer. Certain results of the recent low stages of the river are of peculiar interest.

Under normal conditions, the flow in the delta region, just before the river enters San Francisco Bay, is sufficient to cause the water to remain fresh. However, during the recent low water the flow has been so scanty that the salt water from San Francisco Bay has encroached upon the rich agricultural lands of the delta region, and irreparable harm will follow if the salt water remains long enough to saturate the lands adjacent.

Furthermore, certain industries, including the California-Hawaiian Sugar & Refining Co. and the Southern Pacific Railroad, have built piers at various places in the delta region. These piers rest on wooden piles. In designing these structures it was expected that only fresh water would ever surround these. Salt water would be destructive to these untreated piles if the contact were of long duration. At present the salt water is steadily passing farther and farther up the delta, apparently to remain until the next rainy season. If that occurs, many thousands of dollars of damage will result. Property owners in the delta region have gone to the courts of law and are seeking an injunction against the taking of water from the upper Sacramento River while the low water continues in the delta region. The conference, referred to above, hopes to save the various interests costly and long-drawn out litigation. The importance of rainfall, and the need of wide margins of safety in engineering projects dependent upon it are emphasized in the present situation.

"SNOWBALL" HAIL AT TOPEKA, KANS., MARCH 3, 1920.

By S. D. FLORA, Meteorologist.

[Weather Bureau Office, Topeka, Kans., Mar. 12, 1920.]

Thunderstorms occurred in connection with the passage of an area of low pressure which was central over Dodge City on the morning of the 3d and over St. Louis on the morning of the 4th.

The wind at Topeka during the afternoon blew first from the southeast, then from the east, and later from the northeast at the rate of 8 to 12 miles and hour, with the barometer falling steadily and rather rapidly, occasional sprinkles of rain, the temperatures ranging from 46° to 50° F.

A single loud peal of thunder, the first in several months time, was heard at 4:48 p. m., coming from a dark, threatening cloud in the western sky. At 5:08 p. m. the wind shifted abruptly from northeast to northwest and within 10 minutes had increased to 25 miles an hour; and simultaneously the barometer began a rapid rise. The western sky in the meantime became darker and more threatening. Occasional sprinkles of rain continued to fall. The temperature which was 49° when the wind first shifted, fell rapidly, reaching 34° by 6 p. m.

At 6:27 p. m., following several violent peals of thunder, there suddenly began a fall of what first seemed to be small balls of ice from one-fourth to one-half inch in diameter, which almost covered the ground within the space of 60 seconds. This fall lasted for about 5 minutes. the balls striking objects with the velocity of hail stones and seldom breaking from the impact. Rain was mixed with them somewhat, as it is often mixed with sleet, and, as the temperature was quite close to freezing, the rain froze to limbs of trees and wires catching the balls as they fell so that in a short time trolley wires and telephone wires were soon coated with this mixture of ice and snow, or ice balls, making it very difficult to move street cars and causing much trouble with telegraph and long-distance telephone lines by bringing them down.

A close examination of these ice or snow balls showed them to resemble nothing so much in structure as the compact snow balls—the ones as large as base balls—that boys often make from slushy snow by squeezing and working it. They were fully as hard as hail stones, but lacked the concentric layers of the latter. Within a few minutes after they began to fall the ground was white from them and some that fell on sheltered parts of paved streets and roofs were still there the next morning, frozen in with the ice formed by the rain and sleet, which fell at intervals throught the rest of the evening.

DISCUSSION.

The snowballs, obviously, were hailstones formed by the usual back and forth excursions between higher and lower levels. In the present case, however, the lower levels contained, presumably, only partially melted snow, or snow and rain mixed, and not rain alone. Hailstones formed under these conditions doubtless would be compact, but would not show well-defined alternate layers of clear ice and compact snow—only more or less compact snow throughout. Rain unmixed with snow seems essential to the formation of the layers of clear ice.—*W. J Humphreys.*